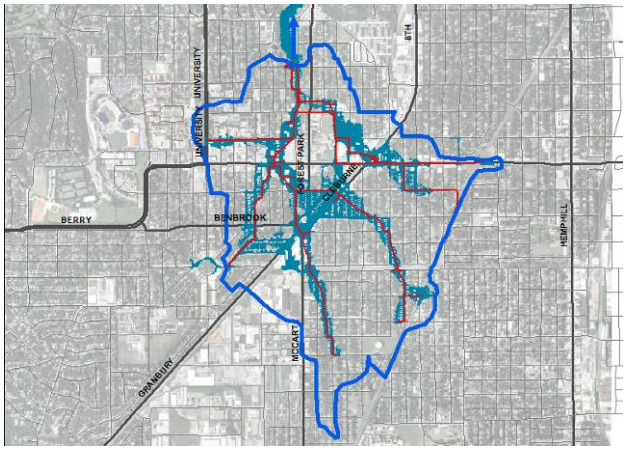
REPORT 2
SUMMARY RECOMMENDATIONS, FOREST PARK-BERRY WATERSHED

1.0 INTRODUCTION/BACKGROUND

This report summarizes a study of feasible options to address flooding in the watershed known as the Forest Park-Berry watershed. This flooding problem has posed challenges to the City of Fort Worth, as all previous solutions identified were extremely expensive and beyond the reasonable funding capacity of the city's storm water utility. The previous solutions were based on application of traditional engineering approaches to a specified design criteria. The Feasible Options Study seeks to identify additional measures using more innovative and alternative approaches that do not necessarily recognize a specific criteria, but do substantially increase the level of service of the drainage system and/or materially reduce existing flood damages.

The fundamental purpose of the study is to identify additional options to the previous recommendations for the watershed for further consideration by the engineering team engaged by the city for the Forest Park-Berry watershed (AECOM). The study is based upon a strong engagement with the project stakeholders and general public, along with a reconnaissance level analysis of potential measures and analyses. This approach allows for a swifter identification and public vetting of potential measures without getting mired in a time consuming and expensive modeling exercise.



The Feasible Options Study has identified measures that can incrementally phased, allowing the city to begin to address flood damages in the Forest Park-Berry watershed. Each project will provide reductions in increments, and over time the sum of these increments will result in substantial reduction in flood frequency and magnitude.

The study identified two separate strategies to address flooding in the Forest Park-Berry watershed. The recommended strategy is the *storage* strategy, with the primary flood reduction measure being the implementation of measures to store excess flooding in the watershed. In addition, a *conveyance* strategy is also considered. This strategy, which involves construction of a tunnel to the Clear Fork of the Trinity River, was identified in previous studies. It is concluded that, due to very high costs, this study does not meet the threshold of "feasibility", and therefore cannot be recommended. However, it is possible that funding sources may be identified in the future, and therefore it is recommended that the conveyance based strategy be subject to further refinement in the event a funding source becomes available in the future.

The two strategies are presented in more detail in the following sections. Section 2.0 presents the *storage* strategy, while Section 3.0 presents the *conveyance* strategy.

This summary report presents an overview of the findings. A more detailed report has been prepared that provides documentation of the analyses supporting the conclusions.

2.0 *STORAGE* STRATEGY

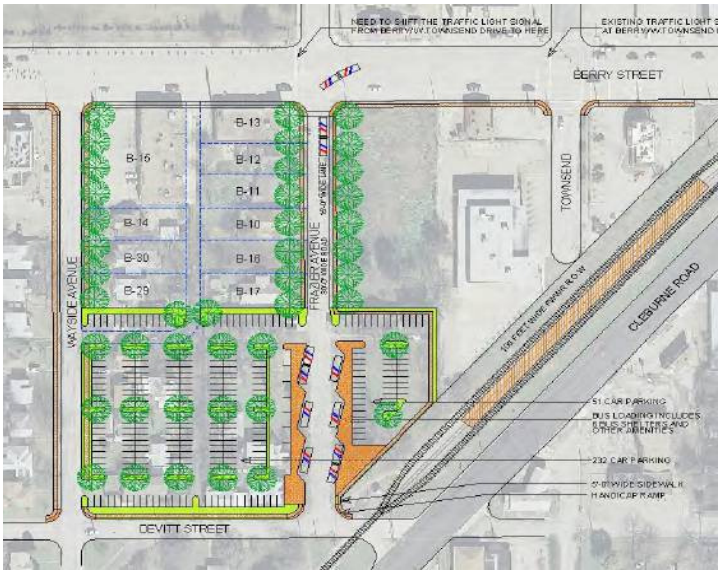
The *storage* strategy involves the implementation of a number of measures to provide dedicated areas to store excess runoff. Currently, the drainage system does not have the capacity to drain the runoff after more intense rainfall events. This results in "excess" runoff that ponds in the streets and eventually in homes and businesses. In essence, this excess runoff is being stored while it waits for the drainage system to slowly drain in off to the Clear Fork of the Trinity River.

The *storage* strategy calls for the establishment of dedicated storage areas to hold this excess runoff, thereby removing it from streets, businesses, and homes. This can be done through the construction of storage basins or ponds; or, if surface land is not available, storage can be obtained through underground structures. Underground structures are much more expensive than surface basins, but limitations in available land often prevent the use of surface basins.

In assessing the watershed, it was determined that it would be desirable to install sufficient storage to hold 68 acre-feet of storage. (Acre-feet is a unit of volume equivalent to one acre of land that is covered by one-foot of water; one acre-foot is approximately equivalent to 1,600 cubic yards). The watershed is currently able to drain about 1.5 inches of rainfall per hour, which is expected to be exceeded, on average, about once per year. The installation of 68 acre-feet of storage will increase the overall level of service of the system. With the resultant system, the system would be exceeded, on average, once every ten years.

The following measures are recommended for providing dedicated storage within the Forest Park-Berry watershed:

2.1 Underground detention in transit surface parking lot. The Fort Worth Transportation Authority, also known as The T, has plans for a future rail station along Cleburne Road just south of its intersection with Berry Street. This includes the construction of a surface parking lot along Devitt Street, between Cleburne Road and Wayside Avenue. Land has been acquired for this project, and plans are to construct the surface lot ahead of construction of the rail station, using it as a parking facility for existing bus service (see exhibit). This measure proposes the construction of underground detention below the surface lot using pre-fabricated storage modules. It is estimate that 12 acre-feet may be obtainable, depending on the layout of the parking lot and the existing trees that remain on the lot.



2.2 Detention in conjunction with transit oriented development plan. As part of the proposed transit station described in Subsection 2.1, the City Planning Department is supporting the use of form-based code as part of a transit oriented development plan. This planning effort, and the establishment of the form-based code, provides an opportunity to incorporate detention features into the anticipated re-development. Since this re-development will be implemented by the private sector, the development interest will be expected to share in the cost of the implementation (the details of this will be worked out in the planning process). Landscape architects would be engaged to develop an urban streetscape plan that incorporates the detention in a creative and aesthetic manner. A concept of what this might look like is shown on the exhibit to the right. It is estimated that this measure can provide approximately 23 acre-feet of storage. This ultimate re-development will likely result in the replacement of the surface parking lot described in 2.1 with a parking garage, and therefore the full implementation of this alternative will result in the loss of the storage provided in 2.1.

2.3 Detention in Biddison railroad corridor. The BNSF railroad has a line that runs east-west between the north and south extensions of West Biddison Street. The rail line has historically bisected the community, and the neighborhood generally considers it a nuisance. It is currently lightly used, and is located such that it would provide a meaningful greenway detention corridor that could store excess runoff and be a community amenity. It is unclear what long-term plans BNSF plans for this corridor. This measure calls for the acquisition of the rail line between McCart Avenue and Ryan Avenue, and the construction of a linear detention greenway in this corridor. This is subject to the City's ability to successfully negotiate acceptable terms with BNSF. It is estimated that this measure could result in the provision of approximately five acre-feet of storage.

2.4 Paschal High School underground detention. The large playing fields associated with the Paschal High School campus provide an attractive location for underground detention, as the pre-fabricated modules are ideal for use under playing fields. Elevation wise, the Paschal campus is substantially higher than the flood prone areas along the main trunk system, so the campus is unavailable for providing storage to addressing flooding in the commercial areas along Berry Street near Savage Avenue. However, there are also flooding concerns related to the local area near the campus. An existing storm drain line runs along Frazier Avenue, between the football/soccer field and the baseball field. The measure calls for the installation of pre-fabricated underground storage modules within the campus. These storage areas will be fed with lateral storm drains installed to connect to the existing storm drain system, and will then gravity drain into the local system when downstream capacity becomes available. Although the soccer/football field and baseball field are expressly mentioned in this report, the underground storage could be provided anywhere on the campus as long as it could be connected to local storm drain lines. It is estimated that this measure could result in the provision of fifteen acre-feet of storage. There is land available for more detention, but a greater volume would cease to be cost effective.

2.5 Watershed-wide detention measures. During the course of this study, a number of smaller potential detention storage measures were identified and evaluated. Many of these measures were not feasible, and others had nominal feasibility. One measure of particular interest is to identify ongoing City projects, such as street reconstruction projects or utility projects, and determine if these projects are in a location where underground detention would be feasible. In cases where it is, cost savings could be realized by combining project purposes. Other ideas were the utilization of the alleys and potentially finding joint projects with Texas Christian University. Without identifying specific measures, it is recommended that the City pursue opportunities for underground detention as they become available in the watershed. This measure is referred to as watershed-wide detention, and it is estimated that the approximately five acre-feet of storage can be identified and installed as part of this measure.

The implementation of these storage-based measures can occur incrementally over time; and during this construction, incremental benefits will be realized. As presented above, it is estimated that approximately 54 acre-feet of storage can be provided using the measures described. This is slightly less than the goal of 68 acre-feet, but would still result in meaningful reduction in flood risk and frequency.

It should be noted that, to be effective, conveyance improvements must be made to the local system in order to convey runoff to the dedicated storage areas. These improvements are described in subsection 3.1.

3.0 *CONVEYANCE* STRATEGY

The fundamental problem in the Forest Park-Berry watershed is that the existing drainage system is under capacity. Therefore, the most direct solution is to increase the capacity of the system. The existing storm drainage system outfalls into a creek known as Zoo Creek, which runs through the Fort Worth Zoo to the Clear Fork of the Trinity River. A simple upsizing of the existing drainage system will result in an increase in flow along Zoo Creek, and would exasperate existing flooding and erosion concerns. Strategies that call for increasing the drainage capacity of the Forest Park-Berry watershed must be formulated in a manner that does not aggravate existing flooding or erosion downstream of the project.

The following measures seek to address the capacity of the existing storm drain system by adding additional drainage capacity:

3.1 Upstream local drainage improvements. The upper portions of the watershed currently drain to roadside storm inlets and then into storm drain lines. There are five "fingers" of the system that convey flow to a major trunk system near the commercial areas near Berry Street and Sandage Avenue. This measure calls for the enlargement of the upstream storm drains, which will then convey the flow to dedicated storage areas (for the *storage* based strategy) or to a new outfall structure (for the *conveyance* strategy, see Section 3.2). The upsizing of the local system should be consistent with the overall strategy, both in size and in timing.

3.2 Construct Tunnel Outlet. This initiative calls for the construction of a sixteen foot diameter tunnel from the intersection of Lubbock Avenue and West Bowie Street to the Clear Fork of the Trinity River near University Drive., as well as a smaller nine-foot diameter tunnel from along West Bowie Street from Sandage Avenue to Lubbock Avenue. It would be tied to the local drainage improvements in Section 3.1. An alternative configuration was identified in the Feasible Options Study that called for the extension of the tunnel upstream to West Biddison Street. The extension of the tunnel would be done in a manner to replace much of the local drainage improvements required as part of the overall strategy. Additional analysis of the tunnel alternatives will be needed. It is should be noted that tunnel projects are often the most likely engineering projects to exceed budget, and a detailed proving of costs should be completed prior to implementation.

5.0 ADDITIONAL MEASURES

In addition to the basic strategies recommended above, the following measures should be implemented.

5.1 Acquire flood prone residences on a voluntary basis, and develop and implement secondary use plan. This recommendation calls for the city to, if approached by the property owner, purchase chronically flood prone homes within the area designated on the following exhibit. Eligibility for a voluntary acquisition would have to be determined, but it should emphasize acquisition of homes that have a history of being impacted by flooding. The city should work with the community to develop an acceptable secondary use plan for these properties, and should see to it that the residual property is

maintained in a manner that meets the community's expectations. The secondary use plan can consider the following options (or other options identified by the city and/or stakeholders):

- *Biodetention/Rain Gardens* – Biodetention, also known as rain gardens, calls for the installation of native vegetation in lower areas with the goal of providing storage of excess rainwater. The native vegetation results in a lower maintenance demand and also facilitates the absorption of runoff.
- *Maintenance Agreements* – These are agreements between the city and another party (typically adjacent landowners, but potentially others or the neighborhood association) where the party agrees to maintain the property and is given the opportunity to utilize the property (often as an extension of their lawn). Acceptable uses would include landscaping or temporary amenities (swings, benches). Unacceptable uses would include structures or fences.
- *Lease Agreements* – These are agreements between the city and another party (typically adjacent landowners, but potentially others or the neighborhood association) where the party leases the property from the City for a nominal amount. The lessee would be responsible for the maintenance, and have the ability to use the property for more potential uses than with a maintenance agreement. They may not construct permanent structures, but they may install temporary structures and fences. The party would exercise care, custody, and control of the property.
- *Community Garden* – The residual property could be established as a community garden. This would likely be managed by the Neighborhood Association through a lease agreement or a maintenance agreement. The Idea is that willing residents could secure a small plot for a vegetable garden. The area would likely be fenced and secured.
- *Pocket Parks* – The residual properties could be developed by the city and/or the neighborhood association as small pocket parks, providing a public amenity for the community. The pocket parks may have active recreation elements such as playground equipment, or they may have more passive elements such as landscaping, picnic tables, and park benches.

This is just a short list of potential secondary uses. If contiguous properties are acquired, the opportunity for secondary uses increases.

6.0 IMPLEMENTATION CONSIDERATIONS

Two separate strategies, a *storage* strategy and a *conveyance* strategy, have been presented for implementation. It is recommended that the city adopt the *storage* strategy, and begin implementation of that strategy. It is also recommended that the city conduct further evaluation and optimization of the *conveyance* strategy. Although very expensive, and not currently affordable given current resources, the conveyance strategy provides for a meaningful reduction in flooding in the watershed. If future funding resources are identified, it is recognized that the *conveyance* strategy will provide a more comprehensive reduction in flood risk.

It should be noted that the two strategies are not mutually exclusive, and the implementation of both storage and conveyance measures is practical. Furthermore, the implementation of storage measures requires the use of local improvements to the conveyance system.

5.0 THE PLANNING PROCESS

This Feasible Options Study was necessary to identify solutions that are (1) effective at reducing flooding, (2) affordable and economically sound, and (3) acceptable to the public. In fact, to be considered feasible, plans must recognize each of these and strive to strike the appropriate balance between them. Each of these three items is presented and discussed in the following section.

5.1 Effectiveness. In order to reduce damages flooding, it is necessary to either (1) increase the ability of the drainage system to move runoff from the neighborhood to the river (conveyance); (2) provide storage areas for excess runoff (detention); (3) decrease the amount of runoff by increasing absorption (rain barrels, pervious pavements); (4) acquire and remove flood prone property (buyout); and/or (5) cope with the flooding (flood insurance, floodproofing). These approaches are not mutually exclusive, and some use of each may be applied. Some of these are more effective than others, and it is important to identify meaningful measures that are effective in reducing flood damages.

Furthermore, there are aspects of particular plans that may hinder construction, and therefore these plans may be considered to lack "constructability". It is important for plans to not only be effective, but to be relatively "constructable".

5.2 Affordability. The economic viability of solutions is important. Not only should plans be affordable, but they must have appropriate value. In terms of affordability, the City has limited funds to address flooding citywide. The cost of any solutions to flooding in the Forest Park-Berry watershed must be affordable within the context of the City's overall capital budget capacity.

Plans must also provide appropriate value. Studies indicate that approximately 300 homes and business are subject to flooding from an event expected to occur, on average, once every one-hundred years. Many of these properties are also subject to more frequent flooding. In total, it is estimated that the net present value of flooding in the Forest Park-Berry watershed is about $100 million. Solutions should be in appropriate scale with this estimated cost of flooding.

With respect to the *conveyance* based strategy developed for the Forest Park-Berry watershed, this strategy does appear to be in appropriate scale. But it does not meet the affordability threshold given current resources. This is the rationale for not eliminating the plan for consideration while not recommending it for implementation.

5.3 Acceptability. Another facet of feasibility is acceptability by stakeholders, who are those most impacted by the proposed solutions to flooding. A number of community meetings were held in order to ascertain the desires and objections of the stakeholders, and to attempt to gain consensus regarding proposed projects.

The section above lists presents three different elements to feasibility. The fundamental challenge is that these three are often in conflict and in tension. Past studies identified plans that are effective and acceptable, but that are not affordable. There are other solutions that are effective and affordable, but not acceptable. And there is a whole universe of projects that are acceptable and affordable, but just do not provide meaningful reduction in flooding.

The City has a fundamental responsibility to its Storm Water Utility rate payers to be stewards of public money, and therefore there a desire to identify the most cost effective solutions. In situations where the city recommends and implements solutions that are not the most cost

effective, it is necessary to (1) present a compelling rationale for pursuing alternative plans, and (2) continue to identify plans that are otherwise affordable and economically viable.

Report 5 contains expanded information regarding recommendations for future Feasibility Planning studies.